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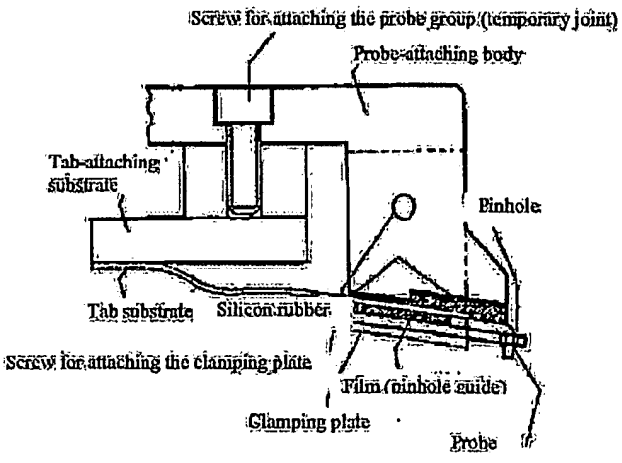
(54) [Title of the Invention] Probe for a display panel

(57) [Abstract] (amended)

[Purpose] To provide a probe for a display panel that significantly reduces testing time.

[Constitution] A connection end is electrically connected to a wiring means of a flexible wiring substrate that has been arranged at the same pitch as the electrodes of a display panel with the wiring means formed, a probe tip that has been attached to match the electrodes being measured is inserted into the probe-guiding portion of a film that has been provided so that the probe is sandwiched with said flexible wiring substrate to form a laminated structure, a probe comprising said laminated structure is attached to a probe-attaching body through an elastic body for providing elasticity to said probe tip, and a plurality of probe assemblies in such a structure is integrally attached to an attachment plate in order to simultaneously obtain electrical interengagement for all the electrodes of the display panel.

[Effects] Increased numbers of electrodes associated with a large-screen display panel can be handled by a combination of probe assemblies having probes in a laminated structure in which a relatively small number of probes have been attached.



[Scope of Patent Claims]

1. A probe for a display panel comprising: a probe assembly comprising a flexible wiring substrate that has been arranged at the same pitch as the electrodes of a display panel with a wiring means formed; a probe in which a connection end is electrically connected to said wiring means and whose tip is attached to match the electrodes being measured; a film that has been provided so that the probe is sandwiched with said flexible wiring substrate and to which a guiding portion with said probe being inserted is provided and a probe-attaching body to which the flexible wiring substrate, probe, and film in said laminated structure are attached through an elastic body for providing elasticity to said probe tip; and an attachment plate to which a plurality of said probe assemblies are attached in order to simultaneously obtain electrical interengagement for all electrodes of the display panel.

2. The probe for a display panel according to Claim 1, wherein said probe assembly is temporarily fixed on an attachment substrate corresponding to one side of a display panel through a temporary joining means, and after the probe assembly is attached to said attachment substrate through a manipulator, it is released from the attachment substrate to allow for the positioning of a probe tip by said manipulator operation.

3. The probe for a display panel according to Claim 1 or Claim 2, wherein said elastic body comprises an elastic material with flexibility, such as a silicon rubber.

4. The probe for a display panel according to Claim 1, Claim 2, or Claim 3, wherein a probe-guiding portion provided to said film is an oval or comb shape along the array direction of the probe.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application] The present invention relates to a probe for a display panel, for example an effective technique utilized for a probe that is used for a large-sized liquid crystal display ("LCD") panel.

[0002]

[Prior Art] Examples of probers for a liquid crystal display panel include Japanese Unexamined Patent Application Publication No. S61-70579. This prober provides an X probe head moving along the X-axis of a display panel at an X-axis stage parallel to a mounting rack, a Y probe head moving along the Y-axis of the display panel at a Y-axis stage, and a third probe head that comes into contact with any position of the display panel at an XY stage moving in parallel along the X-axis and Y-axis of the display panel.

[0003]

[Problem to be Solved by the Invention] In said prober for a display panel with an active matrix liquid crystal display panel, checks for each pixel are performed point by point. Thus, there is a problem in that the testing time becomes significant as the size of the liquid crystal display increases (i.e., has multiple pixels). The purpose of the present invention is to provide a probe for a display panel that can significantly reduce testing time. This and other purposes as well as new

features of the present invention will be described in the descriptions and attached figures below.

[0004]

[Means for Solving the Problem] A summary of the representative examples of the present invention disclosed herein is briefly explained as follows. Specifically, a connection end is electrically connected to a wiring means for a flexible wiring substrate that has been arranged at the same pitch as the electrodes of a display panel with the wiring means formed, a probe tip that has been attached to match the electrodes being measured is inserted into a probe-guiding portion of a film that has been provided so that the probe is sandwiched with said flexible wiring substrate to form a laminated structure, a probe comprising said laminated structure is attached to a probe-attaching body through an elastic body for providing elasticity to said probe tip, and a plurality of probe assemblies in such a structure is integrally attached to an attachment plate in order to simultaneously obtain electrical intercngagement for all the electrodes of the display panel.

[0005]

[Operation] According to the abovementioned means, increased numbers of electrodes associated with a display panel with a large screen can be handled by a combination of probe assemblies having a probe in a laminated structure in which a relatively small number of probes have been attached, thus reducing testing time and facilitating assembly because the probe tip can be inserted into a probe-guiding portion of the film so that the laminated structure is formed by a flexible wiring substrate and the film in order to attach each probe assembly to a probe-attaching body.

[0006]

[Embodiment] Fig. 1 shows a cross-sectional view of one embodiment of the probe for a display panel related to the present invention in which the main section has been enlarged. A tab substrate utilizes a manufacturing technique such as a flexible flat cable and is configured by forming on a flexible film base a wiring layer whose tip has been positioned to match with a plurality of electrode pitches formed on one side of a display panel ("LCD panel") being measured using a photographic technique. A film is formed as a probe guide (pinhole guide) corresponding to the tip of the abovementioned tab substrate. The tip of this film is formed as an oval or comb shape as the probe guide having an array corresponding to the abovementioned electrodes. This probe guide is accurately formed corresponding to the array pitches of the abovementioned electrodes using, for example, a press-punching process, laser beam, or the like.

[0007] For this probe guide, a probe tip made of conducting metal with a relatively high degree of hardness consisting mainly of tungsten or the like is inserted. A probe that is identical to a conventional probe used for a fixed probe board can be used, but it is formed with a considerably shorter length than the conventional one. More specifically, the probe tip of this embodiment is bent at approximately 90° and cut a few

millimeters in from the bent portion. The abovementioned probe guide of the film is accurately formed to match the pitch of the electrodes of the LCD panel, so the tips of each probe can be correctly aligned with the electrodes of the display panel being measured by inserting the bent tips of each probe thereinto.

[0008] As mentioned above, by superimposing the tab substrates over the probes that have been aligned on the film, the connection end of the probes can electrically come into contact with the wiring formed on the tab substrates. To secure more definitive contact, for example, a solder may be used to perform soldering or a connecting media such as an anisotropic conductive film may be used for the connection. The abovementioned soldering can be carried out relatively easily by, for example, forming a solder layer on the connection of the wiring means formed on the tab substrate and the connection end of the probe and then by heat-treating in the superimposed conditions as mentioned above. At this time, a spacer that is slightly thinner than the diameter (height) of the probe may be provided on a surface other than the surfaces on which the probe on the film base is arranged. In this embodiment, the example of silicon rubber is used as a spacer as described hereinafter. As mentioned above, the probe is sandwiched by the tab substrate and film. In this manner, the tab substrate that configures the signal transmission path, the probes that come into contact with the electrodes of the LCD panel, and the film that positions the tips thereof are integrated into the laminated structure. The multiple electrodes corresponding to one side of the display panel are divided in proper proportions and the abovementioned one probe in the laminated structure is provided corresponding to the divided plurality of electrodes. Thus, probes comprising a plurality of laminated structures are used on one side of one liquid crystal display panel.

[0009] The proves in the abovementioned laminated structure are attached on the lower surface of the probe-attaching body through an elastic body for providing elasticity to the tip thereof, such as silicon rubber. The lower surface of the probe-attaching body is given a tapered shaped with an angle to the surface of the liquid crystal display panel. Moreover, silicon rubber as an elastic body is provided corresponding to the probe tips comprising the abovementioned laminated structure. The attachment of the probes in the abovementioned laminated structure to the probe-attaching body is carried out using a clamping plate. This clamping plate is fixed with the support from the lower surface of the film to press onto a supporting surface of the probe assembly. For example, the cross section of the clamping plate in a perpendicular direction to the axis of the probe can be concave, and the lower surface thereof supports the probe in the abovementioned laminated structure to be fixed onto the probe-attaching body by sandwiching the probe assembly between each side. This makes it possible to maintain the laminated structure comprising the film with an appropriate strength and flexibility as mentioned above, a flexible

wiring substrate, and probes for repeatable pressure bonding to a semiconductor chip. One probe assembly corresponding to a plurality of electrodes provided on one side of the display panel is configured by probes, the laminated structure mentioned above, and the probe-attaching body to which the probes are attached through an elastic body such as silicon rubber.

[0010] For wiring formed on the tab substrate, a shield wire may be, for example, provided between the wiring as each signal transmission path to facilitate excellent signal transmission. If a space that forms the abovementioned shield wire becomes insufficient due to the closely spaced wiring layers on the tip, the shield wire is provided on a space other than that space. The probe-attaching body is temporarily jointed by a screw for attaching a probe group onto a tab-attaching substrate. The probe-attaching body may extend to, for example, the leftward direction from the abovementioned temporary jointed portion and is attached to a common attachment plate through a manipulator as described hereinafter.

[0011] Fig. 2 shows a cross-sectional view of one embodiment in which the abovementioned probe assembly is attached to the attachment plate. In this embodiment, the manipulator is attached to a screw (temporary joint) for attaching a probe group provided on the probe-attaching body constituting the probe assembly using a screw B on the right side tip, and is attached to the attachment plate through it. More specifically, an arm of the manipulator that has been fixedly mounted on the upper surface of the attachment plate extends to the downside though an opening of the attachment plate and is fixed by a screw hole and the screw B of the probe-attaching body. An intermediate portion of an arm of an RK manipulator has a through-hole and the abovementioned temporary jointed screw for attaching the probe group is removed through this hole. Therefore, the probe-attaching body is released from the tab-attaching substrate and is finely adjusted in the X, Y, Z, and θ directions corresponding to the arm of the manipulator. This is for correcting mutual displacement through the abovementioned adjustment using the manipulator when the tips of the probe group corresponding to each side by the abovementioned tab-attaching substrate are commonly attached to one attachment body, though they have already been positioned.

[0012] The abovementioned correction of the probe tips is carried out for each probe assembly so that the probe tips of each probe assembly can be matched with each electrode of the LDC panel as shown in Fig. 4 described hereinafter. At this time, a plate for attaching the assembly is fixedly attached to the attachment plate by the screw B and the tab-attaching substrate and probe-attaching body are connected using the flexible wiring substrate (tab substrate). This enables the abovementioned probe-attaching body to freely adjust the position corresponding to the motion of the arm of the manipulator. As mentioned above, when four substrates for attaching the tab are attached to one attachment plate through an attachment substrate corresponding to each side,

one side or the probe tips of all pins are pre-adjusted in order to match with the datum surface using a special adjusting jig, thus significantly simplifying the fine adjustment of the probe tips using the manipulator after attachment to the attachment plate.

[0013] The other end of the tab substrate is attached to a substrate on which a driving IC has been mounted. This driving IC may be, for example, a driving IC that supports a drive circuit on the LCD panel. In this manner, by mounting the driving IC on the tab-attaching substrate, the number of cables between the tester sides can be reduced because a memory circuit (latch circuit) embedded therein can be used. More specifically, this is because data for testing can be input in serial form. Furthermore, in this embodiment, the tab-attaching substrate is directly attached to the attachment plate using a screw A. In addition to this configuration, the plurality of probe assemblies corresponding to one side of the LCD panel may be attached to the attachment substrate so that the substrate may be indirectly attached through it as described hereinafter.

[0014] Fig. 3 shows a plain view of one other embodiment of the probe-guiding portion provided to the abovementioned film. The screw holes do not need to be an oval shape in which each is fully independent, but may be configured so that the minimal distance of the pointed end can be covered when a probe comes into contact with the electrodes of the LCD panel. Thus, as shown in the same figure, the probe-guiding portion may be configured so that the pointed end portion along the array direction of a probe is linked to a comb-shaped gap or may be configured so that the end corresponding to the probe tip of the film base is comb-shaped as a substantial probe guide.

[0015] Fig. 4 shows an overall plain view of one embodiment of the probe for the display panel related to the present invention. In this embodiment, all electrodes of the LCD panel simultaneously come into contact in order to reduce the testing time as described above. In this manner, when all electrodes of the LCD panel simultaneously come into contact, the number of probes provided on the LCD panel corresponding to all the electrodes becomes large and the attachment work becomes difficult and troublesome.

[0016] In this embodiment, said probe assembly in which a relatively small number of probes are fixedly provided is used. More specifically, multiple electrodes having the abovementioned LCD panel are shared in order to allocate each abovementioned probe assembly. In this embodiment, electrodes corresponding to a scanning line disposed to scan in a lateral direction are divided into three to provide three probe assemblies. Furthermore, electrodes corresponding to a signal wire disposed to scan in a direction lengthwise to the LCK panel are divided into four to provide four probe assemblies. In this case, the four probe assemblies disposed in a longitudinal direction to the LCK panel come into contact electrically with both ends of the same signal wire. When the probe is

disposed in this manner, halfway disconnections of the signal wire electrodes can be easily detected by checking the conduction on each end.

[0017] As mentioned above, in addition to the allocation of the probes on each end of the same signal wire, the signal wire electrodes of the LCD panel may be divided into odd-numbered wires and even-numbered wires, for example, an upper probe assembly unit may be alternately connected to odd-numbered signal wire electrodes and a lower probe assembly unit may be alternately connected to even-numbered signal wire electrodes. This makes it possible to reduce the number of probes by half as well as increase the pitch to twice as high as the pitch of the signal wire electrodes. Conversely, a pixel signal is provided to the abovementioned signal wire and disconnections of the signal wire are indirectly detected through a bright spot test or scotoma test. This is also applied to probe assemblies, three of which are provided on both right and left corresponding to the scanning line electrodes disposed to extend into a direction lateral to the LCD panel.

[0018] Each probe assembly provided corresponding to each of the four sides of the LCD panel is temporarily jointed using the tab-attaching substrate shown in the same figure as a dashed line, and the multiple substrates for attaching the tabs may be, for example, attached to the attachment substrate. When the plurality of probe assemblies corresponding to one side on the LCD panel is attached to one attachment substrate, an appropriate positioning jig is used so that the probe tips are aligned in a straight line. This makes it possible to simplify the positioning of the electrodes corresponding to one side of the LCD panel when attaching to a frame-shaped attachment plate. In this manner, a probe board that simultaneously comes into contact with all electrodes of the LCD panel is formed.

[0019] Instead of the abovementioned manipulator, the abovementioned plurality of probe assemblies attached to the attachment substrate may also be assembled by positioning when attaching to the attachment plate using a screw or the like. In this case, a mounting screw may be provided on the attachment substrate and an elliptic hole may be formed in the X direction or the Y direction perpendicular to the X direction across the mounting screw so that the attachment plate may be finely adjusted in the X and Y directions using an eccentric cam. This makes it possible to simplify the probe board configuration, although the probe tips of each probe assembly cannot be easily finely adjusted as in the case of using the manipulator.

[0020] The following are the effects of the operations performed in the above embodiments.

(1) The wiring means corresponding to the electrodes that have been provided one side of a semiconductor tip is formed on the flexible wiring substrate so that the connection end is electrically connected, a probe that has been attached is provided so that its tip is matched with all the electrodes being measured, a guide portion in which the probe is inserted into the film that sandwiches the probe with this flexible wiring

substrate is provided, the laminated structure is attached to the lower surface of the probe-attaching body by pressing from the lower surface using the clamping plate with the interposition of the elastic body for providing elasticity to the abovementioned probe tips in order to configure the probe assembly, and the manipulator that can adjust the positioning of the probe tips in each abovementioned probe assembly is provided, making it possible to handle increased numbers of electrodes associated with the display panel with a large screen by a combination of probe assemblies comprising a relatively small number of probes in the laminated structure, and to obtain the effect of easy assembly.

[0021] (2) Because a fine linear probe (needle) is used for contact with the electrodes of the LCD panel, the probe tip having elasticity rubs the surface of the electrodes in the horizontal direction of the LCD when coming into contact with the electrodes of the LCD panel to remove oxide films or dust on the surface of the electrodes, allowing for the effect of excellent electrical interengagement.

(3) According to the abovementioned (1), all electrodes of the LCD panel can simultaneously come into contact, making it possible to obtain the effect of shortened testing time.

(4) The probes do not need to have elasticity that determines contact pressure itself, and a very fine wire rod can be used as it is fixedly sandwiched between the tab substrate and film. Therefore, it is not necessary to form a vanishing tapered shape as in a conventional probe, making it possible to obtain an effect in which multiple probes can be densely arranged and the probes can be easily processed.

[0022] As mentioned above, the present invention devised by the inventors has been explained in detail based on the embodiments, but the present invention is not limited to said embodiments and various changes may be made without departing from the scope of the present invention. For example, various embodiments can be employed in which a film base or leaf spring being embedded along the tab substrate in addition to a silicon rubber can be used for an elastic body for providing elasticity to the probe in said laminated structure. The number of probe assemblies varies depending on the size of the LCD panel being tested. For example, the aspect ratio of an LCD panel for a laptop microcomputer is not set to 3:4 like with a color television, but is optionally set to 10:4 or another aspect ratio. Thus, for the number of probe assemblies, various embodiments can be employed in which, for example, 10 probe assemblies are provided corresponding to the signal wire and 4 probe assemblies are provided corresponding to the scanning line. The configuration of each member for integrally attaching the abovementioned plurality of probe assemblies corresponding to all the electrodes of the LCD panel can employ various embodiments. The present invention can be widely used as a probe for a display panel for conducting testing of various panel-typed display devices such as an LCD.

[0023]

[Effects of the Invention] The effects to be obtained by the representative examples of the present invention disclosed herein are briefly described as follows. Specifically, the wiring means corresponding to the electrodes of the display panel is formed on the flexible wiring substrate so that the connection end is electrically connected, a probe that has been attached is provided so that its tip is matched with all the electrodes being measured, a guide portion in which the probe is inserted into the film that sandwiches the probe with this flexible wiring substrate is provided, the laminated structure is attached to the lower surface of the probe-attaching body by pressing from the lower surface using the clamping plate with the interposition of the elastic body for providing elasticity to the abovementioned probe tips in order to configure the probe assembly, and the manipulator that can adjust the positioning of the probe tips in each abovementioned probe assembly is provided, making it possible to handle increased numbers of electrodes associated with display panels with large screens by a combination of probe assemblies comprising a relatively small number of probes in the laminated structure so that assembly can be performed easily.

[Brief Description of the Drawings]

[Fig. 1] A cross-sectional view showing one embodiment of the display panel related to the present invention in which the main section has been enlarged.

[Fig. 2] A cross-sectional view showing one embodiment in which the probe assembly related to the present invention is attached to the attachment plate.

[Fig. 3] A plain view showing one other embodiment of the probe guide provided to the film.

[Fig. 4] An overall plain view showing one embodiment of the probe for the display panel related to the present invention.

[Explanation of the Symbols]

LCD: liquid crystal display panel

Figure 2

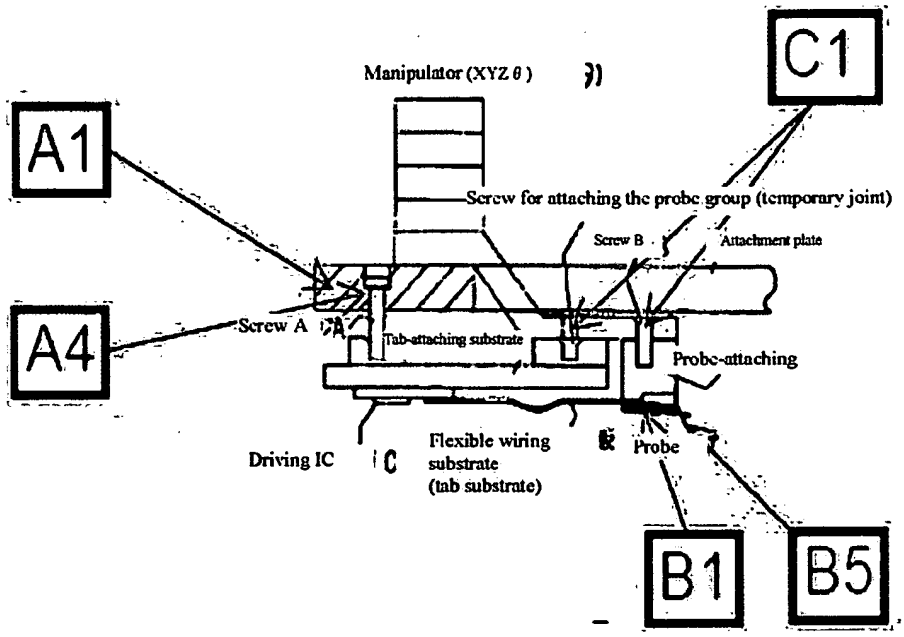
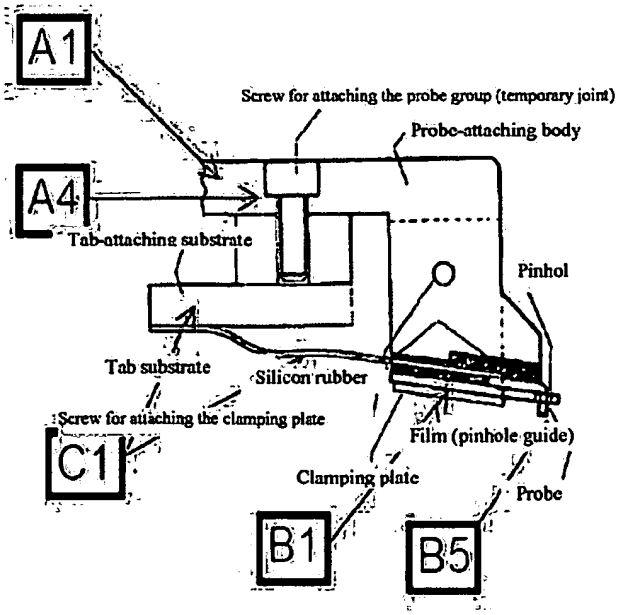
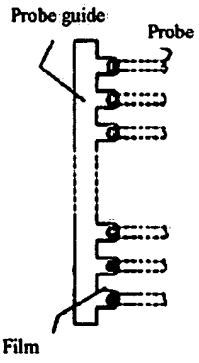
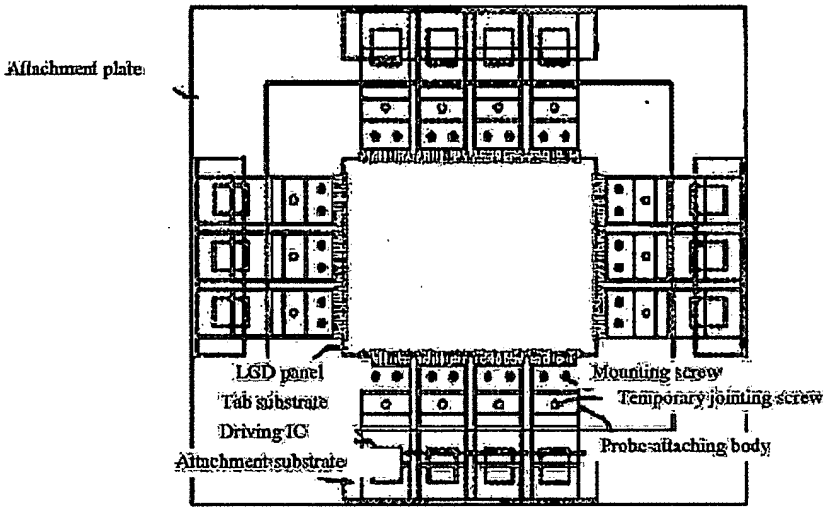



Figure 1

Figure 3




Attachment plate
LSD panel
Tab substrate
Driving IC
Attachment substrate
Mounting screw
Temporary jointing screw
Probe attaching body